U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Sylvilagus transitionalis*

COMMON NAME: New England Cottontail

LEAD REGION: Region 5

INFORMATION CURRENT AS OF: May16, 2006

STATUS/ACTION**:**

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status
_X_ New candidate
___ Continuing candidate
___ Non-petitioned
__X_ Petitioned - Date petition received: August 30, 2000
_X__ 90-day positive - FR date: June 30, 2004
___ 12-month warranted but precluded - FR date
__ Did the petition request a reclassification of a listed species? NO

FOR PETITIONED CANDIDATE SPECIES:
a. Is listing warranted (if yes, see summary of threats below)? - YES
b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? - YES
c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. - During the past 12 months, almost our entire national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, emergency listings, and essential litigation-related, administrative, and program management functions. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on "Progress on our Internet listing actions taken over the 12 months, see the discussion of Revising the Lists," in the current CNOR which can be viewed on website (http://endangered.fws.gov/).

___ Listing priority change
Former LP: ____
New LP:
Latest Date species became a Candidate:
___ Candidate removal: Former LP: ___
___ A - Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or

continuance of candidate status.
___ F - Range is no longer a U.S. territory.
___ I - Insufficient information exists on biological vulnerability and threats to support listing.
___ M - Taxon mistakenly included in past notice of review.
___ N - Taxon may not meet the Act's definition of "species."
___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Mammals, Leporidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, Maine

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Reduced range in New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine. Extirpated in Vermont.

LAND OWNERSHIP: The New England cottontail is found on a mix of Federal, State and private land. The majority of known occurrences are on private land.

LEAD REGION CONTACT: R-5, Diane Lynch, (413) 253-8628

LEAD FIELD OFFICE CONTACT: New England FO, Michael Amaral, (603) 223-2541

BIOLOGICAL INFORMATION:

Species Description

The New England cottontail (*Sylvilagus transitionalis*) is a medium-large sized cottontail rabbit that may reach 1,000 grams (2.2 pounds) in weight. Sometimes called the gray rabbit, brush rabbit, wood hare or cooney, it can usually be distinguished from the sympatric eastern cottontail and snowshoe hare (*Lepus americanus*) by several features. In general, the New England cottontail can be distinguished by its shorter ear length, slightly smaller body size, presence of a black spot between the ears, absence of a white spot on the forehead, and a black line on the anterior edge of the ears (Litvaitis et al. 1991). Like the conspecific eastern cottontail (*S. floridanus*), the New England cottontail can be distinguished from the snowshoe hare by its lack of seasonal variation in pelage coloration. New England and eastern cottontails, on the other hand, can be difficult to distinguish in the field by external characteristics (Chapman and Ceballo 1990). However, cranial differences, specifically the length of the supraorbital process and the pattern of the nasal frontal suture, are a reliable means of distinguishing the two cottontail species (Chapman and Morgan 1973).

Life History Characteristics

The New England cottontail, like all cottontails, is short lived and reproduces at an early age with some juveniles probably breeding their first season. Litter size is typically five young (range 3-8) and females, which provide little parental care, may have 2-3 litters per year. Female New England cottontails have a high incidence of postpartum breeding, demonstrate density

independent breeding response, and have a rapid rate of maturity (approximately 40 days from conception to parental freedom) (Chapman and Ceballo 1990). These characteristics allow a species to thrive in spite of a high predation rate, provided it has ample resources (Chapman, Hockman and Edwards 1982).

Taxonomy

Prior to 1992, the New England cottontail was described as occurring in a mosaic pattern from southeastern New England, south along the Appalachian Mountains to Alabama (Hall 1981). However, Ruedas et al. (1989) and others questioned the taxonomic status of *S. transitionalis* because they found evidence of two distinct chromosomal races within its geographic range. Individuals north and east of the Hudson River valley in New York had diploid counts of 52 while individuals west and south of the Hudson River had counts of 46. Ruedas et al. (1989) stated, "To date, *Sylvilagus transitionalis* represents the only chromosomally polymorphic taxon within the genus *Sylvilagus*" and suggested that the two forms of *Sylvilagus transitionalis* be described as distinct species.

Chapman et al. (1992) conducted a review of the systematics and biogeography of the species and proposed a new classification. Based upon morphological variation and earlier karyotypic studies, Chapman et al. (1992) reported clear evidence for two distinct taxa within what had been regarded as a single species. Accordingly, Chapman et al. (1992) defined a new species, the Appalachian cottontail (*S. obscurus*), with a range south and west of the Hudson River in New York. Thus, the New England cottontail (*S. transitionalis*) was defined as that species east of the Hudson River through New England. No subspecies of the New England cottontail are recognized (Chapman and Ceballo 1990; Hall 1981).

Litvaitis et al. (1997) studied the variation of mtDNA in the *Sylvilagus* complex occupying the northeastern United States. They found no evidence to suggest that hybridization is occurring between *S. transitionalis* and the introduced *S. floridanus*, supporting the conclusions of others that the two species do not successfully cross breed (Wilson 1981).

Habitat

New England cottontails occupy native shrublands associated with sandy soils or wetlands and regenerating forests associated with small scale disturbances that set back forest succession. New England cottontails are considered habitat specialists, in so far as they are dependent upon these early-successional habitats, frequently described as thickets (Litvaitis 1993). Barbour and Litvaitis (1993) demonstrated an obligatory relationship with microhabitats containing >50,000 stem-cover units/ha (20,234 stem cover units/acre). In addition to New England cottontails demonstrating a strong affinity for large patches of heavy cover, they generally do not venture far from it (Smith and Litvaitis 1990). Smith and Litvaitis (1990) demonstrated that when food was not available within the cover of thickets, *S. transitionalis* was reluctant to forage in the open and lost a greater proportion of body mass and succumbed to higher rates of predation than did eastern cottontails in the same enclosure. Thicket habitats and their New England cottontail populations decline rapidly as understories thin during the processes of stand maturation (Litvaitis 1993).

Today, New England cottontail habitats are typically associated with beaver flowage wetlands,

idle agricultural lands, power line corridors, railroad rights-of-way, and patches of regenerating forests (Litvaitis 1993, J. Litvaitis, personal communication). In contrast, eastern cottontails appear to have relatively generalized habitat requirements and sometimes co-occur with the New England cottontail, but also can often be found in residential areas where they utilize private lawns and golf courses, and in active agriculture areas where hedge row cover may be insufficient to support New England cottontails.

The New England cottontail is an herbivore and feeds on a wide variety of grasses and herbs during spring and summer, and the bark, twigs and buds of woody plants during winter. Barbour and Litvaitis (1993) suggested that the winter diet of New England cottontails is related to the size of the habitat patch and that patch size influences forage availability and quality. In smaller habitat patches (<2.5 ha (<6.2 ac)), the density of rabbits is higher and results in less available forage per individual. As a consequence, forage quality declined in smaller habitat patches sooner during winter than did forage in larger patches. For these reasons, Barbour and Litvaitis (1993) considered patches less than 2.5 ha (<6.2 ac) in size "sink habitats" where mortality exceeds recruitment (reproduction and immigration). Subsequent research found that rabbits in smaller patches generally have lower body weights and are presumably less fit (Villafuerte et al. 1997). They also tend to experience greater predation rates (Villafuerte et al. 1997).

Historical Range/Distribution

The New England cottontail is the only endemic cottontail in New England (Probert and Litvaitis 1995). The historic range of the species likely spanned southeastern New York (east of the Hudson River including Long Island) north through the Champlain Valley, southern Vermont, the southern half of New Hampshire, southern Maine and statewide in Massachusetts, Connecticut and Rhode Island (Litvaitis and Litvaitis 1996). The historical range encompassed an estimated 90,000 square kilometers (km^2) (34,750 square miles (mi^2)) (Litvaitis et al. 2006a in press).

Historically, thicket-dependent species like the New England cottontail may have persisted in core habitats associated with frost pockets, barrens, and the shrubby interface between wetlands and upland forests (Litvaitis 2003). These habitats probably were scattered throughout the northeastern United States (Latham 2003). Soil conditions, fire or other disturbances limited forest canopy closure in many of these shrublands (Lorrimer and White 2003, Latham 2003). From these more persistent core habitats, thicket-dependent species such as the New England cottontail could have dispersed opportunistically to occupy smaller, disturbance-generated patches of suitable habitat (Litvaitis 2003).

Although the amount of shrubland and early successional habitat in the pre-Columbian landscape of the Northeast is not well known, it is generally accepted that these habitats were probably never naturally abundant prior to European settlement (Brooks 2003). Fires set by Native Americans, a practice continued by early European colonists, set back forest succession and maintained areas of suitable habitat (Bromley 1935, Cronon 1983). In addition, periodic wild fires and coastal storms such as hurricanes, resulted in an estimated 10 to 31 percent of coastal, pine-oak forests in the seedling-sapling stage (age 1-15 years), a condition providing favorable habitat for the cottontail (Lorrimer and White 2003). In inland forests, where fires were less

frequent, beaver activity and cyclical insect outbreaks set back forest succession. Of the inland forests, about six percent of the landscape is estimated to have been in an early successional stage capable of providing suitable habitat for the New England cottontail (Lorrimer and White 2003, Litvaitis 2003). Another model for inland forests suggests that stand regenerating disturbances were very rare and most early successional forest patches were the result of tree-falls (gap phase replacement) in an otherwise broadly-distributed climax forest (Lorrimer 1977 in Brooks 2003).

Current Range/Distribution

The distribution of the New England cottontail has declined substantially and occurrences have become increasingly separated. Overall, in comparison to the 90,000 km^2 (34,750 mi^2) encompassed in the estimated historic range, the current estimated range covers 12,180 km^2 (4,700 mi^2) (Litvaitis et al. 2006a in press).

Within the current range the presence of habitat that apparently is suitable, in the sense of containing appropriate vegetation structure, does not mean that it is suitable for sustained occupancy by the species. This is illustrated by a multi-state, regional inventory conducted by Litvatis and Tash unpublished data (2005), which determined New England cottontails were absent from 93% of approximately 2,300 habitat patches (referred to as sites) within the recent historical range (1990 to present) that were searched for the presence of the species. Survey results are summarized in Table 1.

Table 1. Regional Inventory of New England Cottontails, 2001-2004. From Litvaitis et al. (2003a) and Litvaitis and Tash, unpublished data (2005).

State	Total Number Sites Searched	Sites with New England Cottontails	% of Sites Occupied
CT	538	22	4.1
MA	374	26	7.0
RI	94	11	11.7
NY	294	14	4.8
VT	73	0	0.0
NH	554	23	4.2
ME	406	58	14.3
Totals	2333	154	6.6

In Connecticut, New England cottontails were found in 22 of 538 sites (habitat patches) searched (Table 1); the occupied areas are in the western and southeastern portions of the state (Litvaitis et al. 2003a and Litvaitis et al. 2006a in press). In a more recent survey conducted by the State of Connecticut, New England cottontails were recorded in 32 of 169 (18.9 percent) towns surveyed statewide (Goodie, Gregonis and Kilpatrick 2005).

In Massachusetts, where the range once was statewide including the islands of Martha's Vineyard and Nantucket, New England cottontails are presently restricted to two widely separated population clusters, one in portions of the Cape Cod peninsula in the east and the other

in the Berkshires in the southwest (Cardoza in litt. 1999; Litvaitis et al. 2003a; Litvaitis et al. 2006a in press).

In Rhode Island, the species was confirmed recently in 11 sites in eight towns in three counties, primarily in the southern half of the state (Tefft in litt. 2005; Litvaitis et al. 2003a).

In New York, the species occurs in Putnam, Dutchess, Columbia and Westchester Counties but is apparently extirpated from Long Island and north of Columbia County (Litvaitis et al. 2003a; M. Clark and A. Hicks, in litt. 2005).

In Vermont, the species has not been documented since 1971 and is believed to be extirpated from the state (Litvaitis et al. 2003a; Litvaitis et al. 2006a in press).

In New Hampshire, the 23 remaining occurrences are restricted to two disjunct areas in Strafford County and the Merrimack River Valley south of Concord (Litvaitis et al. 2003a; Litvaitis et al. 2006a in press).

For Maine, Litvaitis et al. (2003b) reported New England cottontails at 58 of 406 habitat sites surveyed. The current range in Maine encompasses approximately 1600 km^2 (620 mi^2), an 83 percent reduction in the historic range of the species within that state (Litvaitis and Johnson 2002). A similar reduction has been experienced by the species on a rangewide scale. Litvaitis et al (2006a in press) report that the occupied range of the New England cottontail is 12,180 km^2 (4,701 mi^2), which represents a reduction of approximately 86 % of the historic range since 1960

Some of the occupied areas are quite small, support few cottontails, and may be population sinks (see below). For example, two-thirds of the occupied habitat patches in Maine are less than 2.5 ha (6.2 acres) in size and are considered population sinks (Barbour and Litvaitis 1993; Litvaitis and Jakubas 2004). In New Hampshire, more than half of the 23 sites occupied by the cottontail are less than 3 ha (7.4 acres) (Litvaitis et al. 2006a in press). Litvaitis et al. (2006a in press) report that sampled patches in eastern Massachusetts, as well as the majority of those comprising the largest extant New England cottontail population (western Massachusetts, southeastern New York and western Connecticut) are less than 3 ha, probably supporting no more than 3-4 rabbits per site.

The current distribution is fragmented into five apparently isolated core regions. Litvaitis et al. (2006a in press) calculated the geographic range of these 5 areas varies from 1260 to 4760 km^2 (487 - 1840 mi^2), but this substantially exceeds the actual area occupied because the calculation was based on the total area within each 7.5 minute USGS quadrangle where one or more sites with an extant occurrence of the New England cottontail was recorded. The population areas and associated ranges for each are as follows: (1) the seacoast region of southern Maine and New Hampshire, 3,080 km^2 (1,190 mi^2); (2) Merrimack River valley of New Hampshire, 1,260 km^2 (490 mi^2); (3) a portion of Cape Cod, Massachusetts 980 km^2 (376 mi^2); (4) eastern Connecticut and Rhode Island 2,380 km^2 (920 mi^2); and (5) portions of western Connecticut, eastern New York and southwestern Massachusetts 4,760 km^2 (1840 mi^2). There are no known occurrences of New England cottontails outside these five population clusters. Litvaitis et al. (2003a), Litvaitis and Villafuerte (1996), and Litvaitis et al. (in press) believe that these five remaining

disjunct populations of the New England cottontail do not represent a stable condition for long-term persistence.

Based on state by state site visits to most occupied occurrences, the Service estimates that less than one-third of the occupied sites occur on lands in conservation status and less than 10 % of the lands in conservation status are being managed for early successional forest species. Oehler (2003) investigated the extent to which state agencies in 11 northeastern states are creating and maintaining thicket habitats and concluded that "state wildlife agencies are doing little to stem the decline of early-successional habitats on state and private lands in the northeast."

Population Estimates/Status

Historical accounts from the late nineteenth century describe the native cottontail as "common" and Fisher (1898) ((in Eabry (1983)) noted that even though hundreds were killed every winter, they appeared as abundant as 20 years ago. Robust rabbit populations apparently persisted into the mid-20th century, as Litvaitis (1984) found that the New England cottontail was the major prey of bobcats harvested in New Hampshire in the early 1950's.

No estimates are available for the historic or current rangewide population or for the five individual core populations (described above). In Maine, the statewide estimated mid-winter population currently is estimated to be about 250 animals (Litvaitis and Jakubas 2004). Although we do not have quantitative population estimates for areas other than Maine, we believe that the status of the species can be inferred from the status of its habitat. As described above, the range of New England cottontails has been reduced and extant populations are separated by areas of unsuitable habitats such as even-aged forests (Litvaitis 1993) or developed landscapes (Patterson 2003; Noss and Peters 1995; Litvaitis et al. 1999).

Local populations, particularly on small patches of habitat, are vulnerable to extirpation (Litvaitis et al. 2003b). Three telemetry studies of the New England cottontail (Barbour and Litvaitis 1993, Brown and Litvaitis 1995, and Villafuerte et. al 1997) found that rabbits occupying small patches (< 2.5 ha) were subjected to intense winter predation at rates twice that experienced by cottontails on large patches (> 5 ha). Few of the cottontails on the small patches survive long enough to reproduce (Litvaitis et al. in press).

Litvaitis and Villafuerte (1996) used computer simulations to demonstrate that populations dominated by small patches are very likely to go extinct. Thus the status of the New England cottontails utilizing these patches is not considered secure in terms of their ability to contribute to stable populations rangewide. Two-thirds of the 26 occupied habitat patches in Maine are less than 2.5 ha (6.2 acres) in size and are considered population sinks (Barbour and Litvaitis 1993; Litvaitis and Jakubas 2004); sampled patches in eastern Massachusetts and the majority of occupied habitat patches comprising the largest extant New England cottontail population (western Massachusetts, southeastern New York and western Connecticut) are less than 3 ha in size and probably supported no more than 3-4 rabbits per site Litvaitis et al. (2006a in press).

In New Hampshire, more than half of the 23 sites occupied by the cottontail are less than 3 ha (7.4 acres) (Litvaitis et al. 2006a in press). Service biologists recently revisited the 23 sites occupied by New England cottontails in New Hampshire, including the 17 extant occurrences

found in 2001/2002 (Litvatis et al. (2003a), plus 6 occupied sites found in 2003 (Litvatis et al. 2006a in press), to determine their current (2005) status (Tur, USFWS in litt. 2005). Of the 23 sites: 5 were posted for sale for commercial or residential development; 5 associated with power line rights-of-way continued to provide habitat, but this is considered to be temporary because the utility companies conduct maintenance activities to remove vegetation once it reaches a certain height; 6 were in areas with extensive development nearby; 1 was in an apparently inactive sand and gravel mining operation; 4 were in what appeared to be stable, natural habitat mosaics; and 2 have had most of the habitat destroyed due to development and are no longer occupied by New England cottontails. Based on the small size of many of the habitat patches and the rate of development in the surrounding area, the Service believes that the cottontails associated with the majority of the New Hampshire sites where the species currently is extant will be gone in 10 years.

Within the five population clusters, local occurrences of rabbits may be functioning as a metapopulation; that is, a collection of subpopulations on suitable patches of habitat within a matrix of unsuitable habitat, where the local populations are linked by occasional dispersal (Meffe and Carroll 1994; Litvaitis and Villafuerte 1996). The fate of metapopulations is generally determined by the strength of the source population, as well as the dispersal ability of the organism in question. Thus, when localized extinction occurs, the area may become reoccupied due to dispersal from other areas depending on the size and distribution of source populations and dispersal capability. However, with small patch sizes, a declining habitat base and relatively low dispersal ability, the New England cottontail is considered vulnerable to continued reductions in numbers and distribution (Dalke 1937, Litvaitis and Jakubas 2004).

THREATS :

A. <u>The present or threatened destruction, modification, or curtailment of its habitat or range.</u> The New England cottontail requires thicket habitat and is frequently associated with shrublands and other ephemeral stages of forest regeneration after a disturbance such as fire, forest insect outbreak, timber harvesting or beaver activity (Barbour and Litvaitis 1993). Because early successional species require habitats that generally persist only for a short time, continual turnover of forest stands somewhere on the landscape is necessary for the species to maintain its distribution and abundance.

The current amount of early successional forest cover is quite limited in the states where the New England cottontail occurs. U.S. Department of Agriculture data indicate that the area of early successional forest cover in the southern New England states (Massachusetts, Connecticut and Rhode Island) declined from 36 percent of the total timber land area in the early 1950s, to five percent in the late 1990s (Brooks 2003). Jackson (1973) reported a serious decline in New England cottontails in Vermont, New Hampshire and Maine, and attributed the decline to changes in habitat, primarily to the reduction of cover on a landscape level scale. U.S. Forest Service inventories reveal that the extent of forest in the seedling-sapling stage (thickets favorable to the New England cottontail) declined by over 80 percent in New Hampshire from 845,425 ha to 131,335 ha between 1960 to 1983 (R. Brooks pers. comm. in Litvaitis and Villafuerte 1997) and by 50 % in New York between 1980 and 1993 (Askins 1998). While the forest inventory results reported by Brooks (2003) found an increase in the early successional

forest component of northern New England states, most of the increase occurred in the industrial forest land of northern Maine, well north of the range of the New England cottontail. In Maine, young forest stands in the two southern counties that still support populations of New England cottontails declined even more sharply from about 38 percent in 1971, to 11 percent in 1995 (Litvaitis et al. 2002). Litvaitis et al. (1999) reported that remaining shrub-dominated and early successional habitats in the Northeast continue to decline in both coverage and suitability to the wildlife species dependent upon them.

The current decline of early successional forest in the Northeast is primarily due to forest maturation (Litvaitis 1993b), which is a natural process. However, other influences are compounding the situation. Significant habitat destruction and modification is occurring as a result of human population growth and development (Brooks 2003). The three southern New England states, Connecticut (>700 inhabitants per square mile), Rhode Island (>1,000 inhabitants per square mile), and Massachusetts (>800 inhabitants per square mile), which comprise the center of the New England cottontail's range, are among the most densely populated areas in the United States. Only New Jersey and the District of Columbia are more densely populated (U.S. Census Bureau 2000). Similarly, New York, at greater than 400 inhabitants per square mile, ranks sixth among the 50 states in population density. Rhode Island is most developed to the east of Narragansett Bay; the largest forest patches remain along the less developed western edge of the state. Connecticut is most developed in the southwestern corner and up the Connecticut River Valley. Notably, the most densely human populated areas of Connecticut and Rhode Island are relatively devoid of New England cottontails. In association with human populations, early successional habitats that once supported New England cottontails have been converted to a variety of uses that make them unsuitable for the cottontail. Among shrub-dominated plant communities, scrub oak and pitch pine barrens that provide cottontail habitat have been heavily modified or destroyed by development (Patterson 2003). The well-drained, sandy soils of these habitats make them desirable locations for airport development, roadways, sand and gravel mining, industrial parks, cemeteries, and residential and retail developments.

Litvaitis et al. (1999) concluded that shrub-dominated and early successional habitat may be the most altered and among the most rapidly declining communities in the Northeast. Based on changes in human populations and associated development, it is likely that this trend will continue. For example, the U.S. Census Bureau predicts that the Northeast will experience a 7.6 percent change in population by the year 2030 (U.S. Census Bureau 2005). Further analyses of U.S. Census Data demonstrate that in 1982, the number of acres developed for every new person was 0.68 in New England (http://wrc.iewatershed.com), but in 1997 the number of acres developed for every new person was 2.33, an almost four-fold increase. Given the 1997 rate of development for each additional resident (2.33 acres per person) and projected population growth in the New England region, 1.9 million additional acres of wildlife habitat can be expected to be destroyed or modified by development during the period 2000-2010 (adapted from U.S. Census Bureau 2000, (http://wrc.iewatershed.com), and it is highly likely that this will include habitat that currently is suitable and supporting New England cottontails.

As an example, Sundquist and Stevens (1999) estimated New Hampshire is losing 10,000 acres a year of forest land to various types of development. Further, this analysis predicted that the

greatest loss of forest lands, approaching 60,000 acres, would occur in the Southeast corner of the State, principally in Rockingham, Hillsborough, and Strafford Counties. These counties account for 19 of the 23 known New England cottontail occurrences in the state. In fact, as described above, observations by Service biologists in 2005 confirm that 2 of 23 New Hampshire cottontail sites known to be occupied between 2001 and 2003 have already been lost to development and five other sites are posted "for sale."

Noss and Peters (1995) consider eastern barrens to be among the 21 most endangered ecosystems in the United States. Some eastern barrens, such as the pitch pine, scrub-oak barrens of Cape Cod, Massachusetts, are suitable habitat for the New England cottontail. It is unclear to what extent barrens in other states also supported occurrences of New England cottontails, either now or in the past.

Within the historic range of the New England cottontail, the abundance of early successional habitats continues to decline (Litvaitis et al. 1999: Brooks 2003), and for the most part, remaining patches are small and embedded in substantially modified landscapes (Litvaitis and Villafuerte 1996; Litvaitis 2003, Litvaitis et al. 2006b in press)). The fragmentation of remaining suitable habitats into smaller patches separated by roads, residential, and other development can have profound effects on the occupancy and persistence of New England cottontail populations. Barbour and Litvaitis (1993) found that New England cottontails occupying small patches of habitat less than or equal to 2.5 hectares (ha) (about 6 acres) were predominantly males, had lower body mass, consumed lower quality forage, and had to feed farther from protective cover than rabbits in larger patches ($\geq$ 5 ha or 12+ acres). This study also demonstrated that New England cottontails in the smaller patches had only half the survival rate of those in the larger patches due to increased mortality from predation. Barbour and Litvaitis (1993) state that the skewed sex ratios (or single occupant) and low survival among rabbits on small patches may effectively prevent reproduction from occurring on small patches. Due to skewed sex ratios and low survival rates, the presence of New England cottontails in these small patches is dependent on the dispersal of individuals from source populations (Barbour and Litvaitis 1993). Litvatis et al. (2006b in press) and Barbour and Litvaitis (1993) view these small patches as sink habitats.

Natural or anthropomorphic disturbances that create small, scattered openings may no longer provide habitats capable of sustaining New England cottontail populations because in contemporary landscapes, generalist predators effectively exploit prey restricted to such patches (Brown and Litvaitis 1995, Villafuerte et al. 1997). Barbour and Litvaitis (1993) concluded that local populations of New England cottontails may be vulnerable to extinction if large patches of habitat are not maintained. The Service believes this probably explains why 93 % of the apparently suitable habitat patches that were searched by Litvaitis et al. (2006a in press) were found to be unoccupied.

In addition to habitat loss and fragmentation, human population growth has had another effect on northeastern forests. Between 1950 and 2000, the human population increased 44 percent in southern New England and 71 percent in northern New England (Brooks 2003). With the increase in human population, an increase in the parcelization (i.e., the fragmentation of ownership) of northeastern forests into smaller and smaller parcels followed. Currently, the

majority of private northeastern forest owners, excluding industrial forest lands, own less than 10 acres each; about 12 percent of timberland in the Northeast is publicly owned (Brooks 2003). An increasingly urbanized landscape, with many small, partially-forested residential parcels, imposes societal and logistical restrictions on forest management options (Brooks 2003). Shrublands, clear cuts, and thickets are "unpopular habitats" among the general public (Askins 2001) and private forest owners (Trani et al. 2001). Timber harvesting, and fire or other disturbance regimes that would maintain and/or regenerate early successional habitat for thicket-dependent species like the New England cottontail, are less likely to occur in a landscape with many small landowners.

Indirect evidence that the range-wide decline of the New England cottontail is due to the destruction and modification of early successional habitat is provided by research on other thicket-dependent wildlife species. Hunter et al. (2001) reviewed the status of 22 scrub-shrub-dependent songbirds found within the range of the New England cottontail. Of those, 15 were identified as declining, 3 are on the national conservation watch list (prairie warbler (*Dendroica discolor*), blue-winged warbler (*Vermivora pinus*), and the golden-winged warbler (*V. chrysoptera*) , and five are recognized by one or more New England state wildlife agencies as species of conservation concern. The importance of early successional habitat to ruffed grouse (*Bonasa umbellus*) and American woodcock (*Scolopax minor*) is well known and the loss of this habitat has been implicated as a causative factor in the long-term declines of these two birds (Dessecker and McAuley 2001). Among disturbance-dependent bird species throughout eastern North America, Hunter et al. (2001) predicted that many face extirpation from the eastern United States or extinction if early successional habitats continue to decline. Similarly, additional species with an affinity for thicket habitat, including certain plants (Latham 2003), butterflies and moths (Wagner et al. 2003), and reptiles (Kjoss and Litvaitis 2001) are also experiencing declines in abundance and distribution as a regional response to declines in availability of thicket habitat (Litvaitis 2003).

In summary, information currently available indicates that the present and threatened destruction, modification, and curtailment of habitat and range is a significant factor influencing the status of this species. Most New England cottontails now occur on small parcels, where food quality is low and the best available data suggest that winter mortality to predators is unsustainably high (Barbour and Litvaitis 1993, Brown and Litvaitis 1995). Further, the current distribution of the species is discontinuous, being divided by expanses of unsuitable habitat that separate the range into five population clusters. Among the factors contributing to the long term and rangewide reduction in habitat, Litvaitis (1993b) and Litvaitis et al. (2006b in press) considered habitat succession to be the most important cause of habitat loss for the species. However, at a local or individual patch scale, loss or modification of habitat due to development is also significant. Studies on other wildlife species that depend on thicket habitat for survival show a similar decline in both number and distribution due to the growing scarcity of this habitat type in the northeastern United States. In general, the range of the New England cottontail has contracted by 86 percent since 1960 (Litvaitis et al. 2006a in press) and current land uses in the region indicate that the rate of change, about two percent range loss per year, will continue (Litvaitis and Johnson 2002).

B. Overutilization for commercial, recreational, scientific, or educational purposes.

The New England cottontail is considered a small game animal by northeastern state wildlife agencies. It is legally hunted within season and bag limitations in four of the six states known to have extant populations: New York, Connecticut, Massachusetts and Rhode Island. Maine has recently closed the cottontail season (MEDIFW 2004) and New Hampshire has modified their hunting regulations to prohibit the take of cottontails in those portions of the state where the New England cottontail is known to occur (NHFG 2004).

One turn of the century account relative to hunting New England cottontails (Fisher 1898 in Eabry 1983) states that "although hundreds are killed every winter nevertheless they appear to be just as common at the present time as 20 years ago." Tracy (1995) reported extensive hunting as a possible cause for the lack of cottontails at one Connecticut site, but provided no supporting data.

State wildlife agencies believe that current hunting pressure on cottontail rabbits is not severe, and in most states there presently is limited hunting of New England cottontails (E. Parker, CT Dept. of Env. Mgt., in litt. 2004; Stolgitis, RI Div. of Env. Mgt., in litt. 2000). Most states have fewer rabbit and other small game hunters today than in earlier decades (S. Cabrera, USFWS, in litt. 2003; J. Organ, USFWS, in litt. 2002; U.S. DOI and U.S. DOC 1982, 1988, 1993, 1997, 2002), and the New England cottontail is not the rabbit species harvested by most small game hunters. For example, in a recent, 40-month long study of eastern and New England cottontails in Connecticut, 87 percent of the 357 rabbits killed by hunters and examined by the state were eastern cottontails (Goodie et al. 2004). Similarly, in Rhode Island, most rabbit hunting occurs on farm lands, where the eastern cottontail is most often the quarry (Stolgitis, RI Div. of Env. Mgt., in litt. 2000). In New Hampshire, a study in which 50 collared New England cottontails were monitored, only one was taken by a hunter (J. Litvaitis, pers. comm. 2000). Previously, Litvaitis (1993a) stated that hunting restrictions or other non-habitat-based management will likely have no influence on current or future populations of the species.

New England cottontails forage within or close to dense cover (Smith and Litvaitis 2000), and typically hold in safe areas when disturbed. They are therefore not as easily run by hounds and taken by hunters as eastern cottontails or snowshoe hares. Research shows that New England cottontails are more vulnerable to mortality from predation in smaller patches of habitat than in larger ones (Barbour and Litvaitis 1993). This may hold true for hunting mortality as well, because rabbits on small patches eventually exploit food available in the best cover, and they must then venture farther from shelter to feed where there is less escape cover in which to hide.

Rabbits may be regarded as pests and killed by gardeners and farmers. However, because of differences in habitat preference of the two cottontail species, most farmers and homeowners are more likely to encounter eastern cottontails, which occur in the more open habitats of farms and residential lawns, than New England cottontails.

Carlton et al. (2000) suggest that over-hunting of New England cottontails led to their decline in the mid-20th century, and that decline indirectly contributed to the deleterious introduction of eastern cottontails by hunters seeking to compensate for lost opportunity to hunt rabbits. The Service concurs that the introduction of eastern cottontails, a non-native competitor, has been a factor in the decline of New England cottontail populations because eastern cottontails are now

the predominant rabbit throughout all of the former range of the New England cottontail, except for southern Maine. However, available evidence suggests that habitat loss through forest maturation and other causes (Jackson 1973, Brooks and Birch 1988, Litvaitis et al. 1999), rather than hunting pressure, was the primary reason for the decline of New England cottontail populations in the mid-20th century. Thus, on the basis of available information, current human hunting pressure does not appear to be a significant mortality factor or threat for the New England cottontail.

Based on consideration of the information summarized above, there is no evidence that the New England cottontail is over-exploited for commercial, scientific or educational reasons.

C. Disease or predation.

Cottontail rabbits are known to contract a number of different diseases, such as tularemia, and are afflicted with both ecto-parasites such as ticks, mites and fleas, and endo-parasites such as tapeworms and nematodes (Eabry 1968). However, there is little evidence to suggest disease as a limiting factor for this species. DeVos, Manville and VanGelder (1956) in Eabry (1983) stated that introduced *S. floridanus* on the Massachusetts islands of Nantucket and Martha's Vineyard probably compete with the native New England cottontail and that these western rabbits introduced tularemia to the islands. However, it is not known whether tularemia played a role in the disappearance of S. *transitionalis* from the islands. Chapman and Ceballos (1990) do not identify disease as an important factor in the dynamics of cottontail populations. Rather, they state that habitat is key to cottontail abundance and that populations are regulated through mortality and dispersal. Further, they note that escape cover is an essential habitat requirement, suggesting that mortality from predation is an important population regulation mechanism.

Brown and Litvaitis (1995) found that mammalian predators accounted for the loss of 17 of 40 New England cottontails in their study. Smith and Litvaitis (1999) determined that coyotes (*Canis latrans*) and foxes (*Vulpes vulpes*) were the primary predators of New England cottontails in New Hampshire. Litvaitis et al. (1984) noted that cottontails were a major prey of bobcats (*Felis rufus*) in New Hampshire during the 1950s, and were recorded in the stomachs of 43% of the bobcats examined; more recently, it was determined that the cottontails found in the bobcat study were all New England cottontails (Litvaitis, in litt. 2005). Bobcat populations have declined in some northeastern states (Litvaitis 1993), but at the same time, a new predator became established, the coyote. Coyotes first appeared in New Hampshire and Maine in the 1930's, in Vermont in the 1940's and in southern New England in the 1950's (DeGraaf and Yamasaki 2001). Since then, coyote populations have increased throughout the Northeast (Litvaitis and Harrison 1989; Smith and Litvaitis 1999) and even occur on many off-shore islands. Further, coyotes have become especially abundant in human dominated habitats (Oehler and Litvaitis 1996). Other mammalian predators of cottontail rabbits in New England include the gray fox (*Urocyon cinereoargenteus*), weasels (*Mustela* sp.) and fisher (*Martes pennanti*). Avian predation is also considered a significant cause of mortality for New England cottontails (Smith and Litvaitis 1999), and both barred owls (*Strix varia*) and great horned owls (*Bubo virginianus*) took cottontails in a New Hampshire study, where an enclosure prevented losses to mammalian predators. The abundance of hunting perches is believed to reduce the quality of habitat afforded cottontails along power-lines due to predation by red-tailed hawks (*Buteo jamaicensis*) and other raptors (Litvaitis et al. 2006b in press).

New England cottontails are also killed by domestic dogs (*Canis familiaris*) and cats (*Felis catus*) (Walter et al. 2001, Litvaitis and Jakubas 2004). The significance of the domestic cat as a predator on numerous species is well known (Coleman et al. 1997). The domestic cat has been identified as a significant predator of the endangered, Lower Keys marsh rabbit (*Sylvilagus palustris hefneri*) and is considered the single biggest threat to the recovery of that species (Forys and Humphreys 1999). According to the American Veterinary Medical Association (2002), cats occur in 31.6 percent of homes in the United States, and the average number of cats per household is 2.1. Although we do not have direct evidence regarding the role of domestic cats in influencing New England cottontail populations, given the high human population and housing densities found throughout the range of the species, the domestic cat may be an important predator of the New England cottontail rabbit.

Predation is a natural source of mortality for rabbits and under historical circumstances would not have been a factor that posed a risk to species survival. However, the majority of present day thicket habitats supporting New England cottontails are of an insufficient size to provide adequate cover and food to sustain rabbit populations amid high predation rates by what is now a more diverse set of mid-sized carnivores. (Brown and Litvaitis 1995; Villafuerte et al. 1997).

Available evidence suggests that land use influences predation rates and New England cottontail survival in several ways. Brown and Litvaitis (1995) compared the fate of transmitter-equipped New England cottontails with habitat features in surrounding habitat patches. They found that the extent of developed lands, coniferous cover, and lack of surface water features were associated with an increase in predation rates. Oehler and Litvaitis (1996) examined the effects of contemporary land uses on the abundance of coyotes and foxes and concluded that the abundance of these generalist predators doubled as forest cover decreased and agricultural land use increased. Thus, the populations of predators on the New England cottontail have increased substantially .

The abundance of food and risk of predation are very influential in determining the persistence of small and medium-sized vertebrates such as the New England cottontail. Barbour and Litvaitis (1993) found that as food in the most secure areas was depleted, rabbits were forced to utilize lower quality forage or feed farther from cover where the risk of predation was greater, and as a result, New England cottontails on small patches of habitat were killed at twice the rate and were killed sooner than rabbits on larger habitat patches. Further study found that rabbits on small patches were "on the lowest nutritional plane" (Villafuerte et al. 1997). Villafuerte et al. (1997) concluded that forage limitations imposed by habitat fragmentation determine the viability of local populations of New England cottontails by influencing their vulnerability to predation.

Thus, as landscapes become more fragmented, vulnerability of New England cottontails to predation increases not only because there are more predators, but also because cottontail habitat quantity and quality (forage and escape cover) are reduced (Smith and Litvaitis 2000). Rabbits on larger patches were less vulnerable to predation; therefore, large patches of habitat may be essential for sustaining populations of this species in a human-altered landscape. Smith and Litvaitis (2000) report that because eastern cottontails appear to have the ability to forage farther

from cover and detect predators sooner than New England cottontails, eastern cottontails will likely persist while populations of New England cottontails will continue to decline.

In summary, disease does not appear to be an important factor affecting New England cottontail populations. Available evidence suggests that mortality from predation is very important and is linked to habitat destruction and modification. Predation is a routine aspect of the life history of most species and under natural conditions, i.e. prior to settlement by Europeans in the Northeast and the substantial habitat alteration that has followed, predation probably was not a threat to the persistence of the cottontail. Today, however, the diversity of types of predators has increased, the amount of suitable cottontail habitat has decreased, the remaining habitat is highly fragmented, and many habitat patches are quite small in size. Available evidence strongly suggests that predation is the reason why most small thicket habitat patches are unoccupied by cottontails. Similarly, mortality to predation is the fate awaiting most cottontails that do presently occupy small habitat patches, as few rabbits that disperse into those areas or are born there live long enough to breed. Since predation is strongly influenced by habitat quantity and quality, we conclude that the primary risk factor is the present destruction, modification, and curtailment of its habitat and range, and that predation has become an important risk factor due to current habitat conditions.

D. The inadequacy of existing regulatory mechanisms.
There are only limited regulatory mechanisms available to address the destruction or modification of habitat. Habitat impacts are occurring primarily on private lands. Existing zoning ordinances of local governments appear to be inadequate for protecting habitat, since habitat destruction and modification (as described above), as well as increased vulnerability to predation that occurs in small patches, is occurring under zoning ordinances that control development.

Some New England cottontail occurrences are associated with sites that contain or are adjacent to riparian vegetation, such as borders of lakes, beaver wetlands, and rivers. However, the cottontail is primarily an upland, terrestrial species that sometimes occurs along the margins of these wetland types. Federal and state laws that provide protection to shorelands and wetlands offer protection to only a small portion of New England cottontail occurrences.

With regard to hunting and trapping, state wildlife agencies in the Northeast have the authority to control the legal take of New England cottontails by setting hunting and trapping seasons and bag limits. However, most northeastern states cannot presently restrict the take of New England cottontails without also reducing hunting opportunities for eastern cottontails, a common species. This is because the two species are visually similar in the field and they sometimes co-occur on the landscape, even within the same or adjacent habitat patches (Goodie et al. 2004). In Maine, where the only cottontail is the New England cottontail, the state closed the cottontail hunting season in 2004 (MEDIFW 2004). In recognition of the declining status of the species, in 2004/2005 New Hampshire similarly closed the cottontail hunting season in those portions of the state where New England cottontails are known to occur (NHFG 2004).

The species is not presently listed by any of the states as a threatened or endangered species. New Hampshire Natural Heritage Bureau is tracking impacts to the species during the

environmental review process for development projects. New Hampshire Fish and Game is providing project proponents with recommendations to avoid, minimize and mitigate for impacts to the species. However, since the cottontail has not been officially state or federally listed, these recommendations are generally considered voluntary.

The Service has the ability, either through its involvement in the National Environmental Policy Act process or the U.S. Army Corps of Engineers permit process, to become involved in the environmental planning of major federal activities, such as the alignment of new highways, particularly if a proposed alignment could affect a listed or candidate species. Our ability to effect such modifications could mitigate the direct and/or indirect impacts of major construction projects on the New England cottontail in certain situations.

A small proportion (less than one-third) of the areas that have persistent populations of New England cottontails are on lands protected by Federal or state ownership; few of these areas are being managed for early successional species (see Oehler 2003). In the seacoast region of southern Maine and New Hampshire, the Service is not aware of any large habitat patches occupied by the cottontail that are in conservation ownership. In the Merrimack River valley of New Hampshire, there are no protected occurrences of the cottontail. On Cape Cod, Massachusetts, there are cottontail occurrences at two state parks and at a military reservation. While there is no early successional forest management in the state parks, there is a management program in place at the military reservation (Michael Ciaranca, pers. comm. 2006). In eastern Connecticut and Rhode Island, there are a few New England cottontail occurrences on state and federal land, including a state park, a state forest and a national wildlife refuge. Regarding the population cluster in western Connecticut, eastern New York and southwestern Massachusetts, the Service is unaware of any protected occurrences within Massachusetts or New York, but there is at least one state wildlife management area and state forest in western Connecticut where the species can be found.

Overall, within the five population clusters the Service estimates that less than one third occur on state, federal or private conservation land. Further, only a few of the large patches of occupied habitat that do occur on conservation lands have plans and monetary resources in place to ensure the persistence of the species through early successional habitat management. Oehler (2003) reviewed efforts by state wildlife agencies to manage for early successional habitat on state and private lands in the Northeast, and concluded that they were insufficient to stem further decline.

Regulatory protection of habitat for federally listed threatened or endangered species in the Northeast is unlikely to provide the New England cottontail any meaningful habitat protection. Occupied habitat for the New England cottontail rarely overlaps that of federally-listed species in the Northeast. Further, a habitat prescription beneficial to one species may be inimical to another. For example, the clearing of shrubs from a wet meadow to benefit threatened bog turtles (U.S. Fish and Wildlife Service 2001) could have a deleterious effect on any New England cottontails present. Similarly, there are no habitat conservation plans in place for federally-listed species pursuant to section 10 of the Act that will provide habitat protection for the New England cottontail.

In summary, we find that there are adequate regulatory mechanisms to control the legal take of

New England cottontails through hunting, and two of seven states have already afforded the species protection from any legal take by hunters. Available evidence strongly suggests that hunting is not a limiting factor for the species; therefore, the ability to regulate hunting mortality will not be a sufficient conservation measure to reverse the decline in the species. Conversely, other existing regulatory mechanisms have not demonstrated they are adequate to protect the habitat for this species. As a result, through succession or outright conversion from forest to other uses, reductions in habitat and in the distribution and abundance of the species will continue.

E. Other natural or manmade factors affecting its continued existence.
The eastern cottontail was released into much of the range of the New England cottontail and the introduction and spread of eastern cottontails has been a factor in reducing the occurrence of the New England cottontail within its historic range. Tens of thousands of individuals of four or five different subspecies of S. floridanus were introduced to the Northeast, beginning on Nantucket Island, Massachusetts in 1899 (Johnston 1972). The historical range of the eastern cottontail extended northeast only as far as the lower Hudson Valley and possibly, extreme western Connecticut (Goodwin 1935 in Chapman and Stauffer 1981). Large-scale introductions of eastern cottontails to Connecticut (Dalke 1942 in Chapman and Stauffer 1981), Rhode Island (Johnston 1972), Massachusetts (Nelson 1909) and possibly Vermont (C. M. Kilpatrick, in litt. 2002) have firmly established the eastern cottontail in all of New England except Maine. Introductions usually have been conducted by states and private hunting clubs. The eastern cottontail is both larger (1,300 gm or 2.9 lb) and more fecund than the New England cottontail.

In states where researchers and state wildlife agencies reported the New England cottontail had been the predominant or the only cottontail encountered during the early-to-mid-1900s, by the latter half of the century, the eastern cottontail had become by far the most common rabbit (Johnston 1972, Tracy 1995, Cardoza in litt. 1999). Maine, where the eastern cottontail is not known to occur, is the only exception to this pattern. Johnston (1972), in summarizing the history of eastern cottontail introductions, reported that this occupation of new areas by S. floridanus seems to be at the expense of S. transitionalis.

Probert and Litvaitis (1996) found that eastern cottontails, though larger, were not physically dominant over New England cottontails. Later, Smith and Litvaitis (1999) reported that the eastern cottontail had a larger exposed surface area of the eye and consequently had a greater reaction distance to a simulated owl than did New England cottontails. In this way, eastern cottontails have the ability to use a wider range of habitats including relatively open areas such as meadows and residential back yards , compared to the New England cottontail. Through "prior rights" (Litvaitis et al. 2006b in press) eastern cottontails are thereby able to exploit newly created habitats sooner than New England cottontails. Once established, the highly fecund eastern cottontails are not readily displaced by New England cottontails (Probert and Litvaitis 1996, Litvaitis et al. 2006b in press).

An additional factor that may be affecting the status of the New England cottontail is competition with and habitat degradation by white-tailed deer (Odocoileus virginiana). Populations of white-tailed deer have been high enough to cause negative direct and indirect effects on forest vegetation in many areas of the eastern United States since at least the mid-

twentieth century (Latham et al. 2005). In several states (eastern New York, Rhode Island, Connecticut, southern New Hampshire and southern Maine), areas with New England cottontails also support high densities of white-tailed deer at larger landscape scales (J. McDonald, USFWS, in litt. 2005). For example, in Connecticut, deer densities range from nine per square mile in the northwestern portion of the state to in excess of 60 per square mile in coastal areas and in the southeast. In Massachusetts, 35 deer per square mile are estimated for the southern part of the state and 40-60 deer per square mile occur on the islands. Southeastern coastal Maine has 15-25 deer per square mile and southern New Hampshire has 15-20 deer per square mile. In eastern New York, 15-30 deer are estimated per square mile, with local areas having even higher densities.

White-tailed deer are herbivores and eat many of the same plants as cottontails (Martin et al. 1961). In addition, over browsing by deer can eliminate the seedling, sapling and shrub layer within forests (Latham et al. 2005), thereby preventing forest regeneration and the vertical structuring needed by wildlife, including songbirds (deCalesta 1994) and small mammals. Areas with high numbers of deer can appear "park-like" with mature trees in the over story and little woody or herbaceous growth in the understory. At the habitat patch scale, this condition is unsuitable for New England cottontails because they lack both food and cover. Over time, only browse resilient and less palatable introduced plants and native plant species will predominate in the understory of most forests with high deer densities. Cover and the quality of food resources for thicket dependent species like the cottontail will be reduced in these habitats as long as high deer densities persist.

Due to the elimination of large predators like the mountain lion (Puma concolor) and gray wolf (Canis lupus) from eastern forests in the 1700s and 1800s, humans are now the only predators capable of maintaining deer numbers in balance with their habitat (Latham et al. 2005). However, the parcelization and urbanization of the New England landscape in recent decades has resulted in more land posted off limits to hunting, and high deer densities have become prevalent in many areas within the range of the New England cottontail. In view of the above, we believe that high densities of white-tailed deer are a continuing risk factor to the New England cottontail due to the adverse effect deer have on forest regeneration. In addition, they are competitors with cottontails for certain types of food.

Winter severity, measured by persistence of snow cover, is believed to affect New England cottontail survival because it increases their vulnerability to predation, particularly in low quality habitat patches (Brown and Litvaitis 1995). Unlike snowshoe hares, New England cottontails have proportionately heavier foot loading and do not turn white in winter. Villafuerte et al. (1997) found that snow cover reduces the availability of high-quality foods, and likely results in rabbits becoming weakened nutritionally. In a weakened state, rabbits are more vulnerable to predation. Brown and Litvaitis (1995) found that during winters with prolonged snow cover, a greater proportion of the cottontails in their study were killed by predators. Eighty-five percent of the current occurrences of the New England cottontail are within 50 miles of the coast and 100% are within 75 miles of the coast. Litvaitis and Johnson (2002) speculate that snow cover may explain this largely coastal distribution of this species in the Northeast (generally less snow falls and persists in coastal versus interior areas) and may be an important factor defining the northern limit of its range. The preceding studies suggest that a stochastic event, such as a

winter or consecutive winters with unusually persistent snowfall, will reduce the number and distribution of New England cottontails due to predation. This impact would not have been a concern under under historic conditions. However, with the current level of habitat fragmentation and the number of small patches of habitat, coupled with vulnerability to predation in these small patches, winter severity could affect the persistence of local populations and could contribute to further reductions in the range of the species

State wildlife agencies report that road kills are an important source for obtaining specimens of rabbits, including the New England cottontail. Road-killed rabbits were second only to hunting mortality as a source for obtaining cottontail specimens in an ongoing distributional study of eastern and New England cottontails in Connecticut (Walter et al. 2001). However, the degree to which New England cottontail populations are affected by vehicular mortality is unknown

In summary, introduced eastern cottontails and large numbers of native white-tailed deer compete with New England cottontails for food and habitat over much of its range. High density deer populations also reduce the understory structure of forests, and without the protection of dense cover New England cottontails are likely to be subject to greater levels of predation than would occur under historic/more natural conditions.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED:
The states of Maine and New Hampshire have implemented changes in hunting season regulations to protect New England cottontails from hunting mortality.

The New England cottontail has been identified as a "Species of Greatest Conservation Concern" (GCN) in all 7 state draft Comprehensive Conservation Plans throughout the species' range. GCN species are defined as species determined to be rare, imperiled or whose status is unknown. As a result, the species may receive additional attention by managers. For example, New Hampshire suggests development of early-successional habitat networks in landscapes currently occupied by the species (http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm).

The New Hampshire Natural Heritage Bureau is tracking impacts to the species during the environmental review process for development projects. New Hampshire Fish and Game is providing project proponents with recommendations to avoid, minimize and mitigate for impacts to the species.

The New England cottontail is known to occur at Rachael Carson, Ninigret and Mashpee National Wildlife Refuges. These refuges have expressed an interest in managing habitat for New England cottontail; however, only preliminary efforts to restore early successional habitats are being implemented. Quantitative assessments of New England cottontail habitat have not been conducted for the refuges, but of the three sites, Ninigret with about 120 acres of shrub scrub, has the most thicket habitat.

SUMMARY OF THREATS (including reasons for addition or removal from candidacy, if appropriate): Our assessment confirms that populations of New England cottontails are still present in most states in the historic range, but the species' habitat and range have undergone significant decline. Although we do not have numerical population trend data (and it would be

extremely difficult to obtain) it is reasonable to assume that the significant reduction that has occurred in the range and habitat of the species has been accompanied by a population decline. The decline in range is most severe in Vermont, where the species is believed to be extirpated, and least severe in Rhode Island, where about 25 percent of the historic range is occupied. In general, the range of the New England cottontail has contracted by 80 percent or more since 1960 (Litvaitis et al. 2006a in press). Current land uses in the region indicate that the rate of change, about two percent range loss per year, will continue (Litvaitis and Johnson 2002). In a recent survey, the species was found at only about 150 of approximately 2,300 (7 %) of suitable habitat patches within areas occupied since 1990. Forest inventory data document the decline of suitable habitat and curtailment and fragmentation of New England cottontail range. Habitat destruction and modification is resulting from natural succession processes that lead to forest maturation, which are not being balanced by natural processes (e.g. wildfire) that establish early successional habitat, and by destruction and modification of habitat associated with a variety of human uses of the landscape. We conclude that the present and threatened destruction, modification, and curtailment of its habitat and range is a threat to the persistence of the New England cottontail.

Although predation is not normally a threat to most species and we have no reason to believe it was a threat to the species under natural conditions, the alteration of habitat has resulted in conditions that heighten the vulnerability of the New England cottontail to predators. Cottontails dispersing from relatively large patches of habitat may occupy smaller patches where they are more vulnerable to predation (as has been shown through research) and they may not survive long enough to reproduce and have young recruited into the population. The absence of New England cottontails in so many patches of habitat is attributed to predation, particularly in small habitat patches, and to barriers to cottontail dispersal such as developed areas, roads and other unsuitable habitats. This situation is compounded by increased populations of generalist predators. Consequently, we conclude that predation, as exacerbated by habitat fragmentation and the small size of much of the remaining suitable patches of habitat, poses a threat to the species.

Most of the remaining habitat is on private land that is not being managed for habitat conditions needed by the New England cottontail and is not subject to regulatory mechanisms that would require such management. Within the five population clusters, we estimate that less than one-third of the habitat and populations occur on state, federal or private conservation land, and only a fraction of that, perhaps ten percent, is being managed for habitat conditions needed by the species. Regulatory mechanisms are not adequate to address the continued destruction and modification of habitat associated with various types of habitat conversion and fragmentation associated with expanding human populations. We conclude that existing regulatory mechanisms are inadequate to protect the species, particularly with regard to destruction and modification of the habitat and range of the New England cottontail.

In addition, other natural or manmade factors affect the continued existence of the species. Specifically, within its former range, the New England cottontail is being replaced by introduced eastern cottontails, which are now five times more likely to be encountered within the Northeast than the native New England cottontail. Having more generalized habitat requirements that allow it to exist in a wider array of habitat conditions, and being less vulnerable to predation, the

eastern cottontail can outcompete and displace the New England cottontail where their ranges overlap. Also, a direct effect from burgeoning white-tailed deer populations is competition for food, and an indirect adverse effect is the reduction in cover due to overbrowsing by deer, which probably contributes to increased vulnerability of cottontails to predators.

For the reasons described above, we conclude that the New England cottontail meets our definition of a candidate species because we have on file sufficient information on biological vulnerability and threats to support a proposal to list as a threatened or endangered species.

RECOMMENDED CONSERVATION MEASURES: Since the primary threat to the New England cottontail is the on-going loss and fragmentation of habitat, measures that address these parameters are likely to have the greatest conservation benefit for the species. These measures include the following:

- Increasing the functional patch size of "sink" habitats through vegetation management or by increasing the functional size of these types of habitats through enhanced habitat connectivity.
- Maintaining habitat suitability of existing habitat patches by vegetation management.
- Addressing habitat connectivity at a landscape level to increase dispersal potential of the New England cottontail, thereby maintaining historic levels of gene flow.
- Gaining additional knowledge regarding the mechanisms and rates of replacement of the New England cottontail by the eastern cottontail.
- Increasing support for on-going range-wide efforts to survey the species to detect additional declines in the range of the species, as well as to gain an understanding of the densities of existing occurrences. Specifically, the development of a single nucleotide bioassay technique will greatly facilitate this effort. Development of this technique will likely result in significant reductions in the expenses associated with conducting inventories for the species.
- Relocating individuals from small habitat patches where long-term viability is unlikely because of currently proposed development.
- Conducting additional research to better understand the role that exotic invasive species play as a determinant for densities of New England cottontails within currently occupied habitats.
- Developing and implementing Candidate Conservation Agreements and Candidate Conservation Agreements with Assurances. For example, efforts should be made to work cooperatively with utility companies so that maintenance activities involving habitat along utility rights of way are conducted in a manner that will result in either the persistence or long term benefits to the New England cottontail.

LISTING PRIORITY

THREAT			
Magnitude	Immediacy	Taxonomy	Priority

High	**Imminent**	Monotypic genus	1
		Species	2*
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6
Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Rationale for listing priority number:

Magnitude:
The New England cottontail occupies a very specific ephemeral habitat which now is limited in availability and highly fragmented. The natural processes that historically regenerated early successional forest are no longer functioning, and thicket habitat in all five remaining population clusters is subject to natural succession and/or conversion to various types of human developments or other uses that will result in the continued destruction or modification of habitat and further reductions in the range of the species. Further, of about 150 sites recently confirmed to be occupied, the majority are small in size, where the persistence of cottontails is low due to predation. Also, the majority of the occupied habitats for the New England cottontail are on private lands where habitat loss due to both succession and development continues. A small proportion (estimated to be less than one-third) of the areas that have persistent populations of New England cottontails are on lands protected by Federal or state ownership, and it is estimated that less than 10% of these lands in conservation status are being managed for early successional forest species such as the cottontail. Succession also is reducing the availability of suitable habitat on conservation lands because natural processes such as wildfire, which historically would have produced early successional habitat, have been disrupted, and management to perpetuate thicket habitat is insufficient to retain all but a few of those populations in the long term. The species is reduced to less than 15% of the range it occupied in 1960 and habitat loss continues at a rate of about 2% per year. The future of Merrimack Valley New Hampshire metapopulation and the Maine metapopulation appear to be particularly precarious, and may be the next areas where the species experiences further reductions in range and numbers. Based on this assessment, we conclude that the magnitude of threats to the New England cottontail is high.

Imminence: Threats to the New England cottontail are diverse, well documented, and on-going. This is substantiated by a recent range-wide survey in which the species was found to be absent from 93 % of the suitable habitat patches searched within the range occupied by the species since 1990, and by habitat loss that is continuing at the rate of approximately 2% annually. Based on the on-going nature of threats, we conclude that they are imminent.

Is Emergency Listing Warranted? After reviewing the current status, distribution and threats associated with the New England cottontail we have determined that an emergency listing is not warranted at this time. Even though the cottontail is often found in small patches of habitat in a highly fragmented landscape, a catastrophic decline of the species across its entire range is unlikely in the near future. The immediacy of the threats is not so great as to imperil a significant proportion of the species' total populations within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this will be initiated. We will continue to monitor the status of the New England cottontail as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING:
Monitoring protocols have been developed and several state wildlife agencies and national wildlife refuges intend to continue local surveys efforts for the species. Rangewide inventories are planned in the coming year by many state agencies and all FWS refuges with potentially suitable habitat, pending funding for fecal DNA analysis. Given the difficulty in distinguishing this species from the eastern cottontail and the dense cover in which it lives, we believe species identification through fecal DNA analysis is the most cost effective, accurate and least intrusive method to reliably document occurrences. In this manner, occurrence and persistence of the species can be tracked and information can be collected to begin assessing population trends.

COORDINATION WITH STATES:
Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment: ME, NH, VT, MA, NY, CT, RI

Indicate which State(s) did not provide any information or comments: N/A

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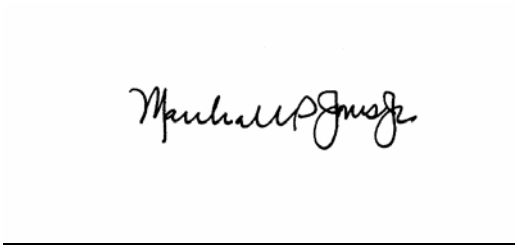
APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all 12-month petition findings, additions of species to the candidate list, removal of candidate species, and listing priority changes.

Approve: /s/ Richard O. Bennett 5/16/2006

Regional Director, Fish and Wildlife Service Date



Concur: August 23, 2006

Director, Fish and Wildlife Service Date

Do not concur:

Director, Fish and Wildlife Service Date